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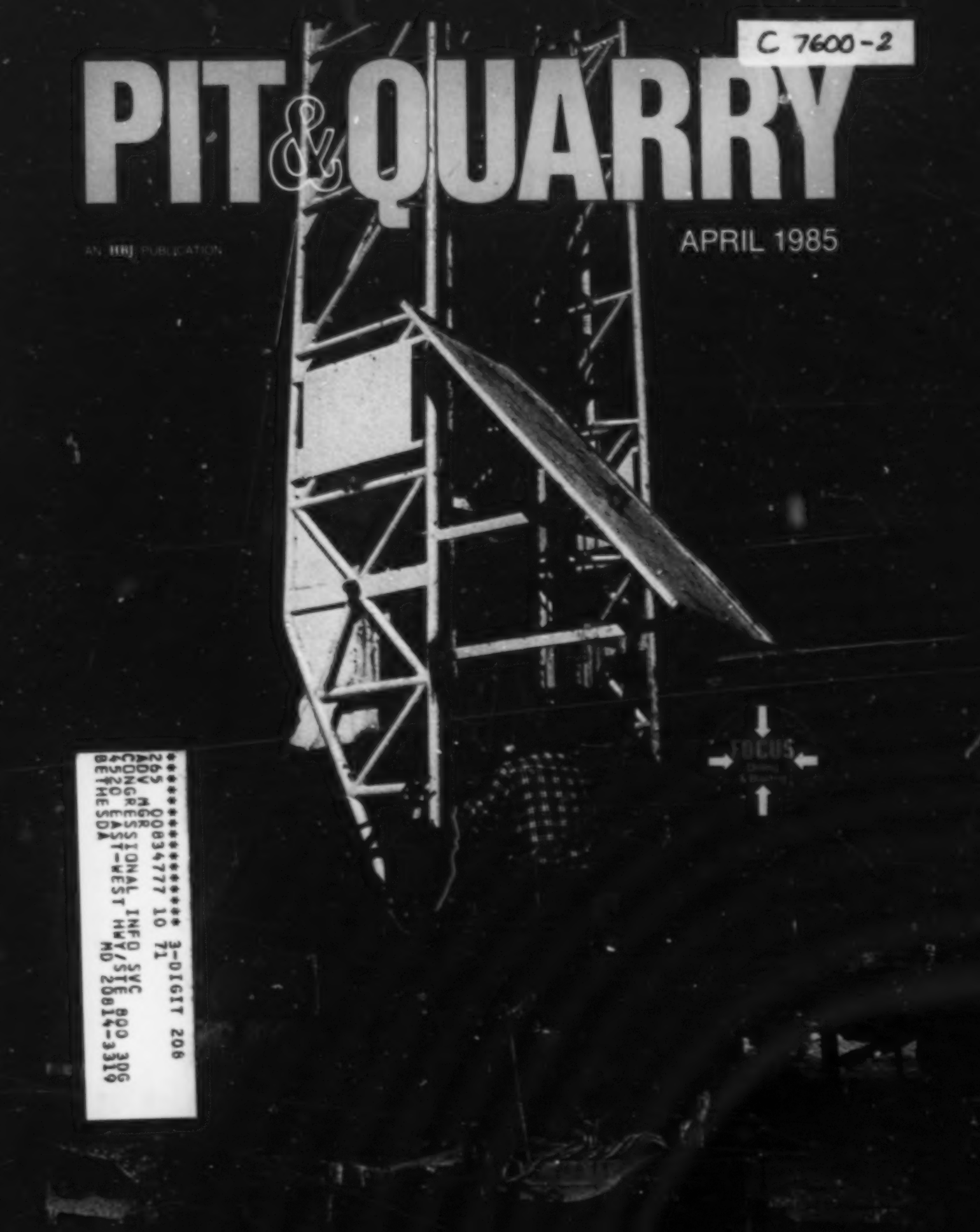
PIT & QUARRY

AN HBJ PUBLICATION

APRIL 1985



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PIT & QUARRY

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ON THIS MONTH'S COVER

Precision drilling is a major contributor to blasting efficiency. Staff photo at Hialeah operation of Tarmac Florida, Inc.

truck topics

edited by Don Michard

Better fuel efficiency reported for truck engine

Caterpillar has announced additional fuel efficiency improvements to 3406B truck engines in the 270 to 320 hp class. The three ratings (310 hp at both 1,800 and 2,100 rpm, and 285 hp at 1,600 rpm) benefit from a package of iron improvements specifically designed to optimize performance and tank mileage for this horsepower class, Cat reports. Improvements include the following:

- New profile hi-lift camshaft provides 50% overspeed protection at 2,100 rpm.
- Low inertia turbocharger improves load response by 40% and startability by 15%.
- A raised ring piston employs a new high compression ratio of 15.2:1.
- Fuel nozzles with new orifice design produce improved atomization and fuel injection patterns for increased combustion efficiency.

Improved response coupled with a 3% gain in fuel economy make these 3406B truck engine ratings highly competitive entries for the fleet and economy segments of the heavy truck market, Caterpillar says. Higher powered versions of the 3406B are scheduled for similar advancements late this year.

Circle No. 148 on Reader Inquiry Card.

It's not too early for summertime maintenance

As winter relaxes its grip, many maintenance crews feel they've survived the worst. After all, vehicles, batteries, and other components seem to find new life when good weather replaces the bad.

Still, it's not too early to think about summertime maintenance programs, according to engineers of GNB Batteries, Inc. That's because hot weather can have an adverse effect on batteries, and no producer wants to be caught with excessive downtime and emergency vehicle maintenance in the middle of a peak production season.

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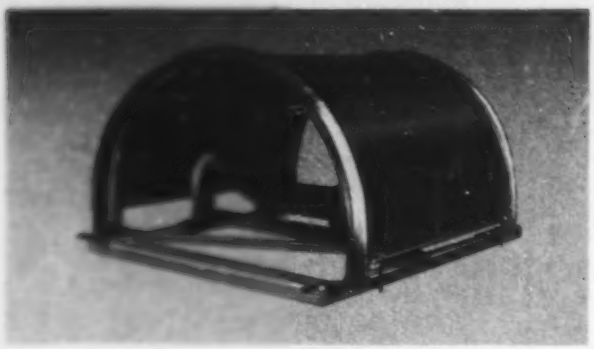

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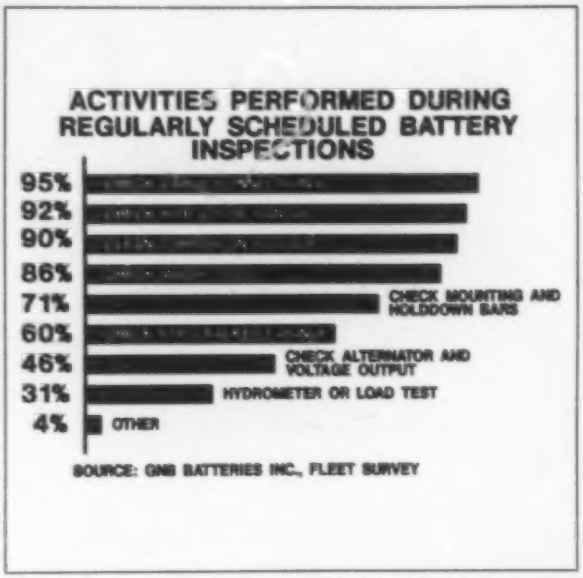
Circle 138 on Reader Inquiry Card

The time to perform careful and comprehensive maintenance on batteries and other critical components is now--or at least before peak operations begin.

Following is a check list of battery maintenance procedures, furnished by GNB Batteries.



How does your vehicle battery scheduled maintenance program compare with other fleet operations? The accompanying chart, furnished by GNB Batteries, Inc., represents responses from 150 fleet operations, coast to coast, to a survey on battery maintenance and purchasing policies.

- Clean battery exterior of salt, dirt, and corrosion. A mild solution of baking soda and water will help. Clean cable connectors also.
- After cleaning, coat the contact surfaces of terminals and cable connectors with mineral grease or petroleum jelly to retard new corrosion.
- Make sure cable connections are bright and tight.
- Replace worn, frayed or cracked cables; they cause electrical resistance.
- Users of conventional antimony batteries should check the electrolyte level and add water if necessary.
- Check holddown bars and make sure all clamps are properly secured. Don't overtighten.
- Check each battery's state of charge; recharge if below 75% of capacity.

Conventional batteries can be checked with a hydrometer. Some maintenance-free batteries do not provide easy access to the electrolyte, so an open-circuit voltage test, or load test may be required. Refer to individual battery testing instructions.

Three points to remember when conducting open-circuit voltage tests:

- Batteries should be at rest at least 2 minutes before open-circuit readings are taken.
- Be sure the voltmeter is in good condition because there can be as little as a one-volt difference between a fully charged and a completely discharged 12-volt battery.
- If the battery has been charged just before test-

Continued on page 58

Continued from page 22

ing (by the alternator, for instance) it probably has developed a surface charge that can influence the open circuit reading. Surface charges can be removed by turning on the vehicle headlights for 1 minute. After turning off the lights, wait 30 seconds before testing the battery.

If using the load-testing option, remember that a battery must be at least 75% charged (equivalent to a 1.230 specific gravity reading or 12.45 open-circuit volts) for the test to be accurate. Be sure to read manufacturer's instructions since load testers come in a variety of styles.

Be careful when working around batteries--during the charging process they generate a highly explosive concentration of hydrogen gas. Charge batteries in an area with good ventilation; keep sparks and flames away. Wear eye protection. If possible, locate the charging station near a washing facility.

Include alternator and voltage regulator in all maintenance checks. Malfunctioning of those components can severly overcharge or undercharge batteries--creating downtime.

If you're storing batteries, check their state of charge every 30 to 45 days. All batteries self-discharge in storage. If they remain partially discharged over long periods, they develop a varnish-like coating on negative plates, making it difficult to return them to full charge again.

Use stored batteries on a first-on-first-out basis, to avoid letting them age excessively. This also protects your manufacturer's warranty. Batteries are warranteed from the date they leave the factory, not the date of purchase.

Check fan and alternator belts for wear and slippage.

Double check battery polarity after installation.

Check for short circuits--they can discharge a battery that is standing idle.

With everything in place, run the engine at fast idle for 10 minutes and use meter to check for alternator and voltage regulator outputs.

Tip: Disconnect ground terminals if vehicles will be parked longer than 10 days. This will eliminate the chance of accelerated self-discharge caused by parasitic electrical loads.

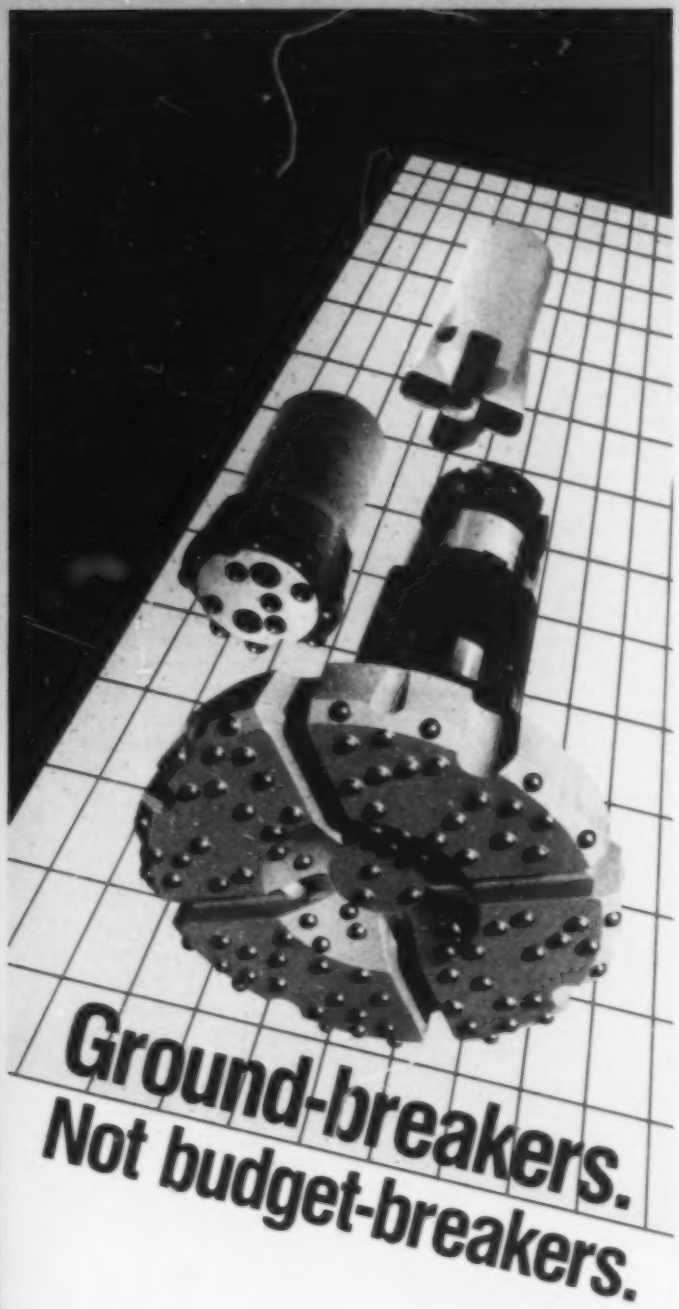
Tandem axle for on & off highway applications

An addition to the 45,000-lb. tandem axle family for on/off highway applications has been announced by the Axle & Brake Division of Eaton Corporation.

Tim O'Boyle, division marketing manager, reported: "Although we have offered the DP451 axles to operators of dump trucks, haulers, drilling rigs, and related equipment, availability was limited to our planetary double reduction gearing. As a response to specific market demands, we have now released a single reduction version--the DS415P."

The DS451 and DP451 are available in ratios from 3.90 to 5.57 and 4.83 to 7.60, respectively, and are specific applications of D401P tandem axles with heavier axle housings designed to support the 45,000 lb. ground loading capacity.

Circle No. 149 on Reader Inquiry Card.



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PIT & QUARRY

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Comparison of 1985/1984 Construction Contract Values*

	1984 Actual ($000,000)	1985 Forecast ($000,000)	Percent Change 1985/84
Nonresidential building	$ 73,328	$ 74,970	+2
Residential building	100,971	108,450	+8
Nonbuilding construction	35,824	37,750	+5
Total construction	$210,023	[illegible]80	+5
Dodge Index (1977 = 100)	148	157	

*Based on statistics compiled by F.W. Dodge Div., McGraw-Hill Information Systems

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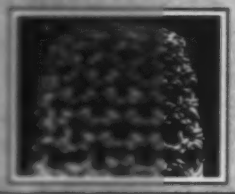

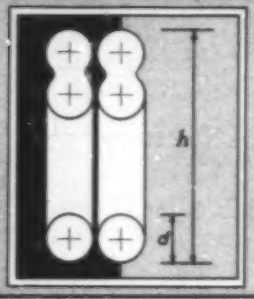

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Coming Events

NATIONAL ASSOCIATIONS

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Circle 123 on Reader Inquiry Card

Fluidized bed combustion offers potential markets for limestone

By Jay R. Read, P.E.

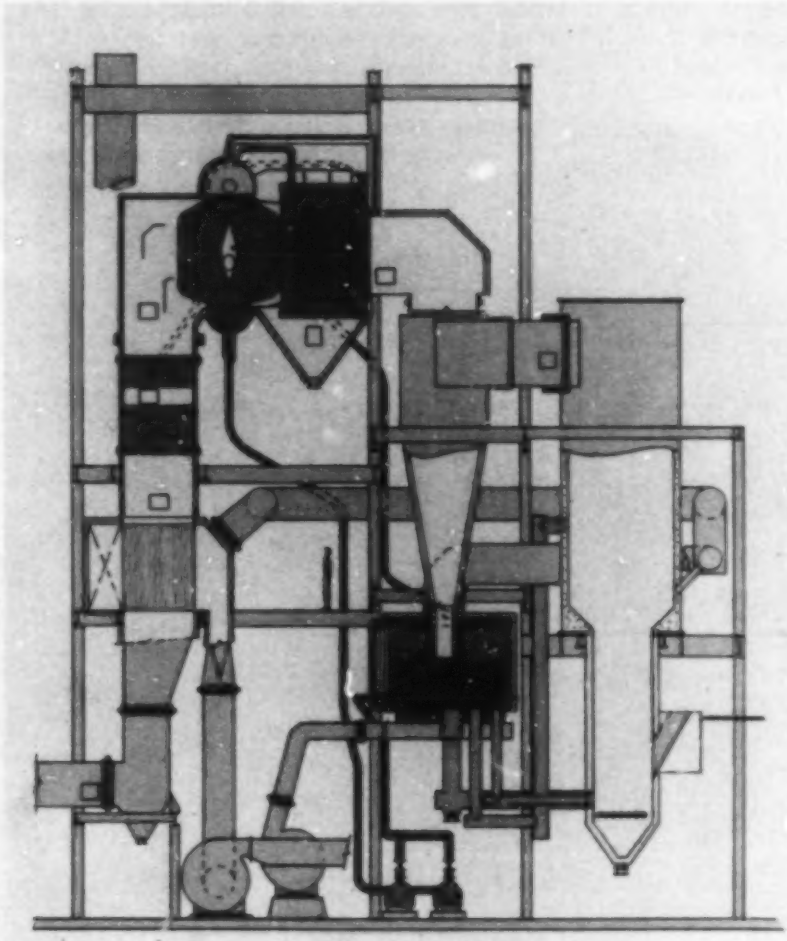
Conventional boilers, which burn solid fuels for generation of steam, usually burn these fuels on a stoker or in burners that mix the pulverized fuel with combustion air. With fluidized bed combustion (FBC), the combustion process is somewhat different. In the FBC boiler, air is blown through a grid plate, a plate full of holes or nozzles, at a sufficient velocity to overcome the weight of the solids on top of the grid plate. The solids, referred to as the bed, consist of the fuel, usually mixed with limestone or sand, that act like a boiling liquid when fluidized.

The amount of fuel that can be burned depends upon the amount of air blown through the bed. When air flow is reduced below the fluidizing velocity, the bed slumps, stopping the agitation and mixing of fuel and bed material. For start-up, liquid or gas fuel is used to warm the bed to a temperature that will ignite the solid fuel, and then the warm-up fuel is turned off.

Steam is generated by ducting the hot combustion gas through a boiler or by tubes located in the bed or by a combination of the two. Water circulated through the boiler and bed tubes is heated to produce steam.

FBC boilers offer a number of advantages over conventional types. Compared to conventional systems, the agitation of the fluidized bed creates higher combustion efficiency and heat transfer for producing steam. Combustion temperatures are rather low (1,500°F to 1,700°F), thus producing lower levels of nitrogen oxides and furnace slag. When limestone is mixed with the fuel in the bed, the sulfur is captured from the fuel, reducing sulfur dioxide emissions and eliminating the need for gas scrubbers. A wide variety of coals and solid fuels can be burned, an advantage that offers good flexibility in fuel purchase or use of waste fuels.

Initial concepts of FBC design usually are credited to work in Germany during the 1920s. Additional development was undertaken in Great Britain and in the United States during the 1950s and 1960s. Current design and development are directed primarily toward combustion of high sulfur coal with reduction of nitrogen oxides and sulfur dioxide from the boilers. Recent sales and installations of coal-fired FBC units, worldwide, have demonstrated acceptable reliability for commercial use of this technology.



Circulating fluidized bed combustion steam generator, 150,000 lb./hr.

Basic types of FBC

Units may be characterized by the velocity of air passing through the grid plate. Low velocity designs, which fluidise the bed without carrying the bed materials out of the combustion furnace, are known as bubbling bed designs. When higher velocities are used, the air flow entrains the bed materials and particles are conveyed out of the combustor and collected in a separate cyclone. This design is known as a circulating FBC because materials collected in the cyclone are recycled to the combustor. Applications for the bubbling bed design are normally in the smaller sizes, under 150,000 lb./hr. capacity, while the circulating bed types show greater economy in the larger sizes. The drawing is of a circulating FBC design.

There are other variables to these basic designs. Some units employ two beds, one for combustion, the second for sulfur capture. Units may be partially shop-assembled or field-erected. Modular designs are available. The boiler or steam generation portion of the unit is designed to suit the particular installation, and may include furnace tubes, drums, convection section, superheater, and economizer. Particulates leaving the boiler normally are collected by a fabric filter baghouse before gases are discharged through a stack.

How limestone is used

For sulfur capture, calcined limestone in the bed reacts with sulfur in the fuel to form calcium sulphate. The limestone is the sorbent and its effectiveness in reducing sulfur dioxide depends upon the characteristics of the limestone and fuel, the combustion temperature, and the molar ratio of calcium to sulfur in the bed. For sulfur dioxide removal in the range of 80% to 90%, the molar ratio of calcium to sulfur generally is in the range from 2 to 4, depending upon other variables.

The reactivity of the limestone and, therefore, the value to the user, depends upon its purity, size, and other qualities. The safest approach to determining if a limestone is a suitable sorbent is to conduct a pilot test on the proposed limestone and fuel. Various FBC designs require different sizes for limestone and fuel. It may be useful to conduct friability studies on the limestone.

Fluidized Bed Boiler Sales in the United States

Date of Commercial Operation	Number of Units	Total Steam Capacity, lb/hr
1973-75	6	120,000
1976-78	16	291,000
1979-81	21	687,000
1982-84	27	1,807,000
1985-87	25	6,416,000
Unspecified	7	1,868,000

(Data condensed from that appearing in *Power*, February 1985)

As an example of the limestone requirements, assume that a 3% sulfur coal requires 80% removal of sulfur dioxide to meet environmental regulations and that an FBC system is used with a calcium to sulfur molar ratio of 2. The system would require approximately 360 lbs. of average limestone per ton of coal burned or approximately 19% by weight.

Sales and installations of FBC systems, starting in 1973, are shown in the accompanying tabulation. While less than half of these installations will use limestone beds (some will use sand or inert bed materials), the list nevertheless indicates a potential for increased limestone use. In general, installations using a low sulfur fuel may not require a limestone sorbent. Some may use both sand and limestone. ●

Jay R. Read is a registered professional engineer and managing partner of Brown Engineering Co., Consultants, in West Des Moines, Iowa. His firm is active in the design of U.S. fluidized bed boiler projects.

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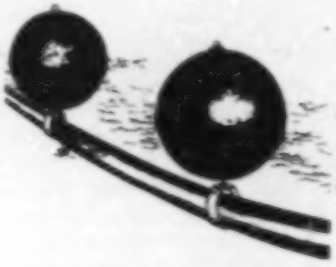

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